Thermo SCIENTIFIC

Operating Instructions DB-100 E

RadEye SPRD

Spectroscopic Radiation Detector



REVISIONS SHEET:

Rev.	Rev. state	Dept. resp.	Name	Rev. page	Cat. *)	Explanation
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A	29.07.14	RM&SI-E	Trost	Cpl.		
B	15.09.14	RM&SI-EH	Pijahn			Firmware **V1.04**
C	04.11.14	RM&SI-EH	Pijahn			Firmware **V1.07**

*) Category C: editorial correction
I: clearing improvement
A: substantial amendment

Explanations must be given, at least with Category A.

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SAFETY INSTRUCTIONS

Do not use the unit if error messages appear on the screen.

The earphone connector at the bottom side of the instrument must be exclusively used by equipment that is specified for use with RadEye SPRD.

The instrument must not be used in explosive atmosphere.

The RadEye SPRD is not intended to be used as a personal dosimeter. No neutron dose rate or dose calculation is performed. Due to the high detector sensitivity the gamma dose rate measuring range of the RadEye SPRD is limited to 250 µSv/h (25 mrem/h). For higher dose rates (indicated by "Overload") an underestimation of the integrated gamma dose can be expected.

The RadEye SPRD shall not be used for measurements in pulsed fields.

WEEE Compliance:

This product is required to comply with the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2002/96/EC. It is marked with the following symbol:



Thermo Fisher Scientific has contracted with one or more recycling/disposal companies in each EU Member State, and this product should be disposed of or recycled through them. Further information on Thermo Fisher Scientific compliance with these Directives, the recyclers in your country, and information on Thermo Fisher Scientific products which may assist the detection of substances subject to the RoHS Directive are available at **www.thermo.com/WEEERoHS**

1. Introduction

The RadEye SPRD radiation pagers are highly sensitive and rugged measuring devices to detect and localize gamma and neutron radiation sources.

Furthermore, by virtue of the so called NBR-technique (natural Background Rejection) the RadEye SPRD pagers separate man-made (non-NORM[1]) gamma radiation from natural background fluctuations. As well, the energy compensated dose rate of gamma radiation (Sv/h) can be measured. In this context it is important to note, that users may select "R/h" as a display unit, with the understanding that the energy response characteristic is not altered by this selection. Within the RadEye SPRD the relation 1 R = 1 rem = 10 mSv is used.

The instrument is designed to meet the requirements in the ANSI standard 42.48 in respect to gamma radiation.

1

Natural **O**ccurring **R**adioactive **M**aterial (NORM).

The RadEye SPRD incorporates a single CsI (Tl) Cesium Iodide Scintillator which is equipped with a miniature silicon photo-multiplier (SiPM) allowing the detection of very low radiation levels.
While the RadEye SPRD does not contain a specific thermal neutron detector, it does analyze specific characteristic features of the measured gamma spectrum to indicate the presence of a neutron source.

The RadEye SPRD pager identifies to the user whether the alarms are due to gamma or neutron by a different colored alarm LED, different tones and flashing the count rate / dose rate display readings with an inverted display background of the alarming channels or both channels as appropriate. The RadEye SPRD also has different audible alarms discriminating between elevated background/NORM and any artificial isotope alarm also the gamma and neutron audible alarms are clearly different. This gives the RadEye SPRD audible and visual identification using NBR of the type of material detected.

The last 1600 mean and maximum values of gamma count rate, neutron count rate and gamma dose rate data points are recorded internally and can be read out via serial interface.

Additionally the last 250 alarms, errors and changes of the configuration are logged. All events can be read out via serial interface.

A real time clock is provided to add a time stamp to all buffer data.

The RadEye SPRD enables measurement of detector pulse rates and energy compensated dose and dose rates.

All menu functions described in 3.4 can be configured to be invisible.

Thus the instrument can be configured to both, an extremely simple mode allowing just LCD-illumination and alarm acknowledgment to a very versatile mode for the more experienced user.



2. Installation and start-up

2.1 Scope of delivery

The RadEye is delivered in a folding paper box together with two AAA cells, a rubber protection sleeve and an operating manual.



For optional accessories see chapter 12.

3.3.4 View saved spectrum

With menu item “View spectrum” in sub menu “Nuc ID Settings” a saved spectrum can be loaded and displayed.



Edit value by pressing ▲/▼ keys, select digit by ◄/ ► keys. After entering digits and leaving low digit with the ► key the data is loaded and nuclides are identified. The result is displayed in the same way as described in chapter 3.3.3.

3.3.5 Trigger list

With menu item “Trigger list” in sub menu “Nuc ID Settings” certain nuclide can be excluded from nuclide identification. The trigger list can be edited with PC-program “radeye.exe” (see 8.4.4).

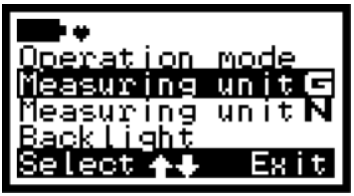
3.4 Menu functions

To enter the operating menu, press the “Menu” key.
Scrolling through the single menu options is effected by the “▲/▼” arrow keys.
The display returns to its initial default setting in case no key has been activated for more than 10 seconds.
A ✓, when found behind some menu options, means that the respective function is active.

3.4.1 Main menu

The main menu offers the following displays:









The above illustration depicts all main menu options for the standard configuration.

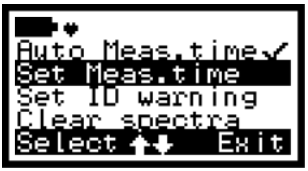
Using the PC-Software and an interface adapter, the functions can be hidden. This allows the user to be given only the functions necessary to accomplish his measurement duties, thus simplifying the handling considerably.

To select a menu option or a sub menu, highlight the desired action and press the left key

The meaning of the Menu key may change with the selected menu. The meaning is shown on the bottom of the display.
Change: Edit Alarm values
Off, **On**: Switching a function on and off
Select: Select a default display mode
Yes: Confirmation of an action
Exit: Exit menu
In Change menu the Up-/Down arrow keys are used to change a digit of an alarm value.

MAIN MENU DISPLAY	DESCRIPTION OF THE FUNCTION OR SUB MENU ACTIVATED BY THE LEFT KEY
Switch off	RadEye is switched off. Time and stored data and spectra are maintained.
Nuc ID settings	*SUB MENU Nuc ID settings* See 3.4.2
Text Info	Displays the text info stored in the RadEye
Show Alarm	Display of alarms stored in alarm log.
Alarm Indication	*SUB MENU ALARM INDICATION* See 3.4.3
Settings	*SUB MENU SETTINGS* See 3.4.4
Clear Dose Gamma	Sets the measured gamma dose to zero and resets Over-load messages.
Edit Alarms	*SUB MENU EDIT ALARMS* See 3.4.5
Scaler Parameter	*SUB MENU SCALER PARAMETER* See 3.4.6
Operation Mode	*SUB MENU OPERATION MODE* See 3.4.7
Measuring unit **G**	*SUB MENU MEASURING UNIT GAMMA* enables the following measuring units: - cpm - cps - rem/h - R/h - Sv/h See 3.4.8
Measuring unit **N**	*SUB MENU MEASURING UNIT NEUTRON* enables the following measuring units: - cps - cpm See 3.4.8
Backlight	Backlight always on/Backlight extinguish after 10 s.
Scaler Backgnd	*SUB MENU SCALER MODE BACKGROUND* See 3.4.9

3.4.2 Sub menu “Nuc ID Settings”





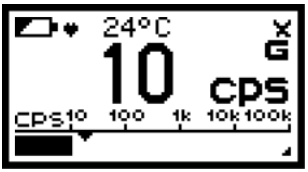
SUB MENU “ID SETTINGS”	DESCRIPTION OF THE FUNCTION
Auto Meas.time	If selected, the RadEye will identify the measuring time. If deselected, the ID measurement uses the predefined time.
Set Meas.time	Edits the measuring time used for measurement with fixed time
Autosave	If selected, the RadEye saves the spectrum after measurement is complete.
Load spectrum	Loads a saved spectrum (see 3.3.4)
Trigger list	Select a predefined trigger list for nuclide identification
Backgnd spectrum	Starts a background measurement
Send spectrum	Sends the current spectrum in XML-N42.42 format.
Clear spectra	Deletes all saved spectra
Set ID warning	Modifies warning thresholds for Neutron count rate and Gamma dose rate

3.4.3 Sub menu “Alarm indication”

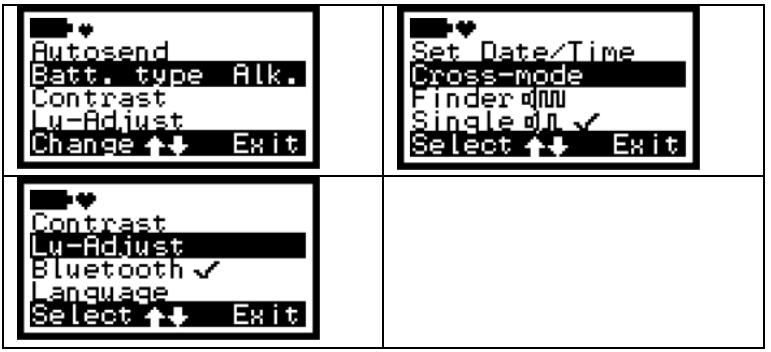


SUB MENU “ALARM INDICATION”	DESCRIPTION OF THE FUNCTION
Sound	The transducer is enabled / disabled
LED	The Alarm LED is enabled / disabled. This flags it for gamma and neutron LED.
Vibration	The vibration alarm is enabled / disabled
LCD LED	If enabled, the backlight turns on for 10s if an alarm is detected.

If sound and vibration alarm are disabled at the same time a cross is displayed in the upper right corner.



3.4.4 Sub menu “Settings”

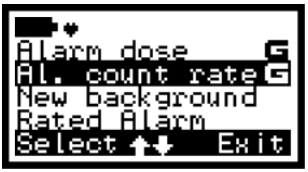


The above illustrations depict all main menu options for the submenu “Settings”.

SUB MENU “SETTINGS	DESCRIPTION OF THE FUNCTION
Contrast	Adjusts the contrast of the LCD display
Lu-Adjust	Setting the detector amplification
Set Date/Time	Sets date and time of the real time clock.
Language	Sets language to English, German or French
Crossmode	In this mode the measurement value of the dose rate is displayed together with the bar graph of the cps value.
Finder	Enabling and disabling of audible radiation intensity. Activation is done by audio keys (right button and top button).
Single	Enabling and disabling of single pulse indication. Activation is done by audio keys (right button and top button).

Battery type	Switching between battery type Battery and NiMH. It is used for the correct warning of low battery.
Autosend	If activated, the instrument sends a data string periodically to the infrared port. This is used for radio transmission units.
Bluetooth	This menu item enables/disables the BTcom cover. It is only visible when the BTcom cover is present

3.4.5 Sub menu "Edit alarm"





SUB MENU "EDIT ALARM"	DESCRIPTION OF THE FUNCTION
Al. count rate G	Edits the alarm threshold 1 and 2 of count rate gamma (measuring unit cps, cpm and cross mode). If the measuring unit is set to R/h, rem/h or Sv/h the menu item will be re-named to "Al. dose rate G".
Al. count rate N	Edits the alarm threshold 1 and 2 of count rate neutron
Alarm NBR	If selected, the NBR function is active (see 5.2)
Alarm dose G	Edits the alarm threshold 1 and 2 of accumulated dose gamma.
New background	Forces the RadEye to start a new background measurement

Rated Alarm	If active, the vibrator, sound and LED are changing their intensity with the radiation level intensity.

3.4.6 Sub menu "Scaler parameter"



SUB MENU "SCALER PARAMETER"	DESCRIPTION OF THE FUNCTION
PresetTimeMode	Preset time mode is used to measure a predefined time. The time can be modified with menu item "Set time/count"
PresetCntMode	Preset count mode is used to measure a predefined number of counts. The counts can be modified with menu item "Set time/count"
Set wait time	"Set wait time" is used to edit a wait time before the scaler measurement is started. (see 3.2.3)
Accum. Counts	"Accum. Counts" means the RadEye displays the accumulated counts instead of the mean value. This option is only effective with measuring units "cps" or "cpm".
Auto restart	With "Auto restart" the RadEye restarts automatically the measurement

Set time/count	“Set Time/Count” edits the preset time and counts.
Bluetooth	Enable/Disable BT-com cover

3.4.7 Sub menu “Operation mode”



This submenu is used to select between ratemeter (see 3.1), scaler (see 3.2) and Nuc ID (Nuclide identification, see 3.3) mode. The “✓” shows the active mode.

3.4.8 Sub menu “Measuring unit” (G / N)

Measuring unit Gamma:





Measuring unit Neutron



This submenu is used to select the measuring unit for ratemeter and scaler measurements. Cps is the recommended measuring unit.

3.4.9 Sub menu “Scaler Backgnd”



The above illustration depicts all main menu options for the submenu “Scaler Backgnd”.

SUB MENU “BACKGROUND”	**DESCRIPTION OF THE FUNCTION**
Set Parameter	Edits the preset time and counts for Gamma and Neutron used for background measurement (see 3.2.4)
Start Meas.	Performs a background measurement
Ratem. netto	If selected, ratemeter values are displayed with background subtraction
Scaler netto	If selected, scaler values are displayed with background subtraction

3.5 Alarm thresholds

There are two alarm thresholds each allocated to dose gamma, dose rate gamma, count rate gamma and count rate neutron.

Two rate alarm thresholds corresponding to the chosen basic display mode are active. The two active rate alarm thresholds are marked at the bar graph (See 3.1.1 and 3.7).

Additionally the two gamma dose thresholds are active.
In order to avoid dose alarms while using the instrument exclusively as a rate meter, the dose alarms can be set to the maximum level.

It is possible to configure the alarm threshold 2 for dose rate as a safety alarm via the PC-program RadEye.exe.

In that case the dose rate alarm threshold 2 is always active regardless of mod or units.

Configuration of the alarms is possible via infrared interface (chapter 8.4) or via the menu.
As to the alarm activation, please also read chapter 4.3.

3.6 Gamma alarm threshold based on the relative standard deviation (sigma threshold)

In case the sigma value is set between 2 and 9, the first gamma alarm threshold is calculated every second from the count rate of the background rate meter according to an empirical equation referring to the usage of the pager in a stable natural background. Thus the actual alarm threshold adjusts itself automatically to the existing background radiation level. The actual setting of the alarm threshold 1 can be observed at the bar graph threshold mark (triangle) if the gamma only display is selected. At instrument start, the background rate meter starts with its maximum value of 100 cps, reaching its final value after 30 seconds.
Using the menu option **Alarm Cnt. Rate**, the exact value of the alarm threshold currently valid at the respective background can be displayed.

After acknowledgement of a sigma-alarm, the background ratemeter is set to the actual count rate. Accordingly the alarm threshold is increased and is fine adjusted during the next 15 seconds after acknowledgment. For this time the message “Learning” together with a progress bar is displayed.

Alarm 2 is always referring to the total count rate without consideration of any learned background.

Recommended Sigma values:
Sigma = 6 enables almost false alarm free searching in areas with a fairly constant radiation background.

3.7 Setting alarm thresholds

The menu options **Al.count rate G** , **Al.count rate N**, **Al. dose rate G** and **Alarm dose G** from the sub menu allow the alarm thresholds to be modified. For this setting, the user has 255 seconds time. Changing the value is effected by pressing the left (Change) button if the corresponding "Alarm" is selected:

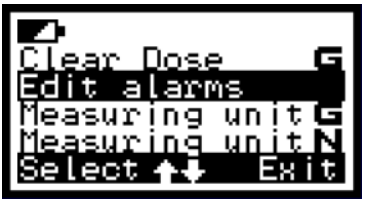
To increment the number, press the ▲/▼arrow keys. To go on to the next digit or to quit the edit mode, menu use ►/◄arrow keys.
Once the last number has been set, quit the editing mode by pressing the "Exit"-key. Then, the value set is saved and the unit returns to the basic display.

Please note: Using the unit cpm will allow setting the gamma alarm with a multiple of 60 cpm and the neutron alarm with a multiple of 6 cpm.

Example:

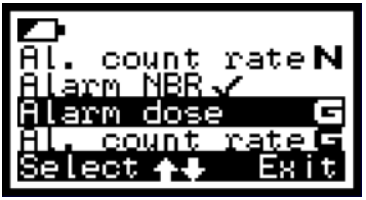
The dose alarm threshold must be changed.

Press “Menu” key, and ▲/▼arrow keys until **Edit alarms** is selected



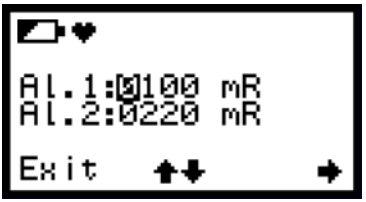
Then enter the sub menu by pressing the “Select” key.

Press the up/down arrow keys until **Alarm dose G** is selected.

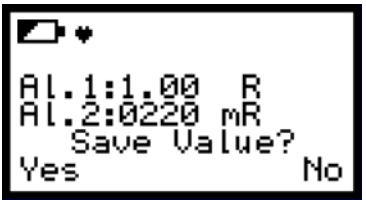


Then enter the sub menu by pressing the “Select” key.

Edit value by pressing ▲/▼ keys select digit by ►/◄ keys.
Pre unit “µ”, “m” may be chosen as well.



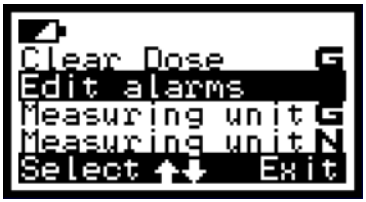
Leave the last digit with the ► arrow key:
Confirm storage of edited value pressing “Yes”



Example:

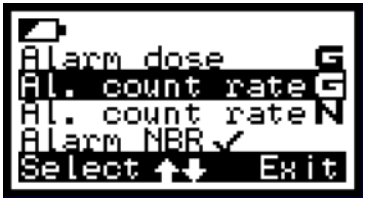
The sigma value for the gamma count rate alarm threshold must be changed.

Press “Menu” key, and ▲/▼ arrow keys until **Edit Alarms** is selected



Then enter the sub menu by pressing the “Select” key.

Press “Menu” key, and ▲/▼ arrow keys until **Al. Count rate G** is selected



Then enter change menu by pressing “Select” key.

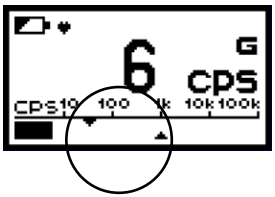
Edit value by pressing ▲/▼ keys

Sigma-Alarm: 0: off: Al.1 can be set as a constant threshold.



Sigma-Alarm 2....9: Al.1 is calculated from the actual background. Actual value is displayed.

Save settings by leaving the menu.



The set points of the actual alarm thresholds are seen at the marks on the intensity bar scale. The upper mark shows alarm threshold 1, the lower mark shows alarm threshold 2

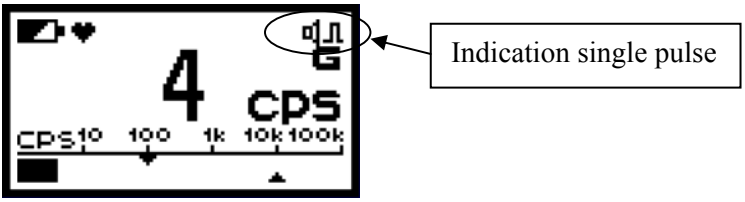
4. Operation

4.1 Audible single pulse indication and finder mode

With the single pulse indication being selected, every pulse of the detector generates a short audible signal emitted by the beeper.

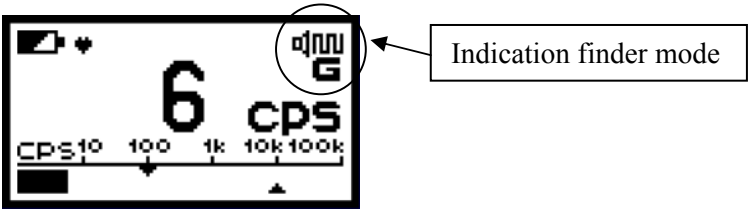
An audible alarm signal caused by exceeding the alarm threshold is not given while single pulse indication is active.

The single pulse indication must be enabled in the menu.
It is activated and deactivated by two times pressing the right or top button:



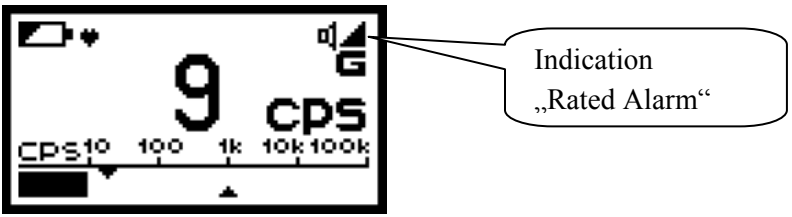
In the Finder mode, the sound frequency depends on the pulse rate of the detector. The more detector pulses above the count rate that is present at the moment of the activation of the finder mode are captured by the detector, the higher the tone.

The finder mode must be enabled in the menu.
It is activated and deactivated by two times pressing the right or top button:



4.2 Rated alarm

Rated alarm can be enabled in the sub menu “Edit alarm”. If active the vibrator, sound and alarm LED are changing its intensity with the radiation level.



4.3 Alarm indication

Each time the first alarm threshold is exceeded, the alarm devices beeper, LEDs and the vibrator become active, if they are enabled.

Alarm 1 Gamma:
Red LED blinking, two frequency alarm tone

Alarm 2 Gamma:
Red LED blinking, continuous alarm tone

NBR-Alarm (Gamma):
Red LED blinking, sweeping alarm tone

Dose Alarm (Gamma):
LED constantly on, continuous alarm tone.

Alarm 1 Neutron:
Blue LED blinking, scratchy alarm tone

Alarm 2 Neutron:
Blue LED blinking, scratchy alarm tone
Except for the dual line display, additional text info is provided.

Example (alarm by Ba-133):



Gamma only page



Dual display page

The alarm tone and vibrator are acknowledged by a short key depression of the right arrow pushbutton, the LED remains pulsing. The alarm is extinguished, when the first alarm threshold of the neutron and the gamma measurement value is remained under.





With the PC-program “RadEye.exe” the alarm threshold 2 of the dose rate can be configured as a safety alarm (see 3.5).

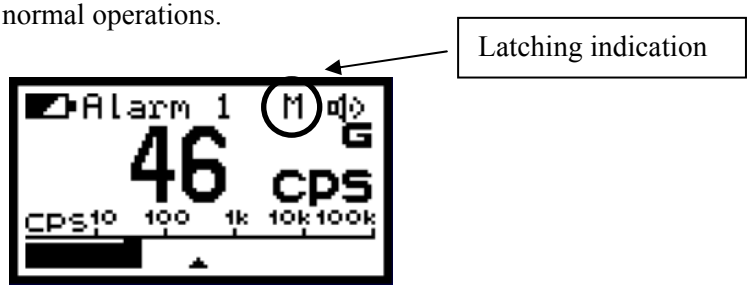
4.4 Additional information

In addition to the basic display, using the menu options, requests for further information can be started such as e.g. the setting of the operation mode and the enabling and disabling of the various alarm indicators.

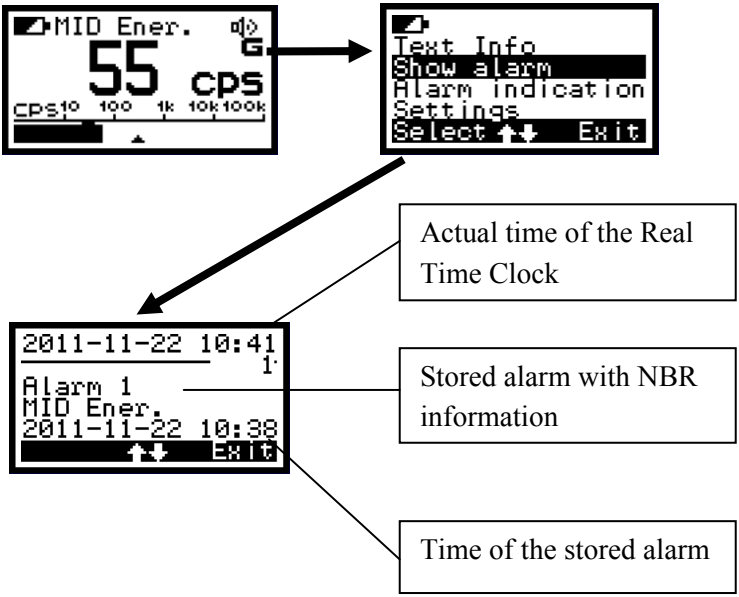
Using the upper arrow key, additional measuring values are displayed (see chapter 3.2.1).

4.5 Alarm latching

Via PC-program it is possible to configure an alarm latching. Alarm latching means the alarm is stored for the configured time from 0 s (= off) to 9999 s.
A latched alarm is indicated by an “M” near the alarm indicator. When the alarm is acknowledged the RadEye returns to normal operations.



By selecting the menu point “Show alarm” the alarms stored in the alarm log are displayed together with the time of alarm and the actual time.



By pressing the up and down arrow keys you can scroll through the alarm log. By pressing the right button the display returns to the menu.

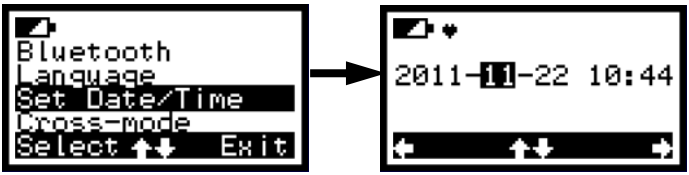
4.6 Text Info

Via PC program “RadEye.exe“ it is possible to place a text information in the RadEye SPRD. This text information can be displayed with the menu function „Text Info“.



4.7 Set date and time

Alternatively to the setting of date and time by the PC-program, these changes can as well be performed via the menu function Settings → Set Date/Time.



The format YYYY-MM-DD hh:mm is used. The fields are selected with the keys right/left. With the keys up/down the Year, month, day, hour or minute can be changed. After setting the date and time the real time clock is set and is used for alarm logbook, history and spectra time stamp.

4.8 Battery type

Selection of battery type: Rechargeable NiMH or non-rechargeable batteries. It is needed for a correct low battery warning.

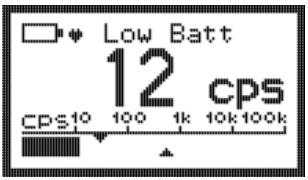


Battery type “Alkaline”



Battery type “NiMH”

If the battery voltage is below the configured threshold the following warning appears:



The beeper generates a tone sequence every 30s. This acoustic warning can be suppressed by pressing the alarm acknowledge key. After 8h this warning comes up again. The battery needs to be changed. However, the RadEye can still be operated for several hours.

If the battery voltage falls below 2.1 V, the battery symbol starts flashing. An acoustic warning is generated every 8s and can’t be acknowledged. The battery needs to be changed as soon as possible.

4.9 Lu-Adjust

A “Lutetium Test Adapter” (see 12.3) containing 36 g Lu2O3 is recommended to perform the following tests. Alternatively the Test adapter 42508/1029 with 6 g Lu2O3 can be used, if sufficient time is available.

Since the primordial natural isotope Lu-176 (36 Billion years half-life) is not part of the normal background radiation, it is identified by the NBR-circuitry as non-NORM (MID energy) isotope.
Thus for training purpose the response of the RadEye SPRD to man-made gamma emitting radioactivity can be field tested with a natural and license free ceramic material. Lu-176 must be recognized by the NBR as described in chapter 5.2.

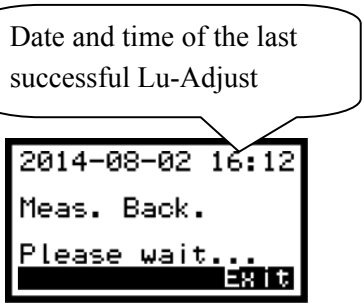
As well, the test adapter can be used to quickly verify the proper function of the nuclide ID – both in the field and for training purposes! Typically a Lu-176 ID is indicated after less than 60 s for the 36 g test adapter and after less than 5 minutes for the 6 g adapter.

Furthermore this test adapter can be used for verification and fine-adjustment of the internal detector high voltage. Start the Lu-Adjust via submenu “Settings” -> “Lu-Adjust” without the test adapter.

During the first seconds the RadEye checks the background.

Please note that the background must be smaller than 25 cps and that the net count rate of the test adapter must be greater than 30 cps!





When the background measurement is complete the user may place the test adapter:



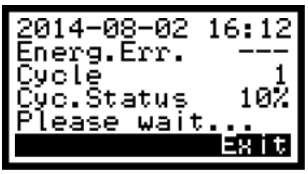
Place the Lu-adapter.





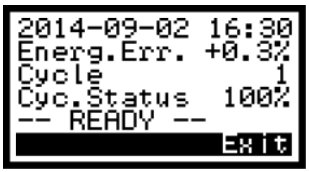
The RadEye recognize the test adapter automatically and starts the adjust routine. No further action is required.

The status of the adjustment is shown in the display.



Depending on the test adapter used and the corresponding count rate the test takes a few minutes and ends with an acoustic signal.

The result is displayed. A successful test ends with the message "-- READY --". If the high voltage is outside of adjustment range the message "Inspection" is displayed. In this case or if the Lu-Source is not recognized automatically the instrument should be send to Thermo Fisher Scientific Messtechnik GmbH, Service Center or to Columbia U.S. Depot Service for inspection.



Successful Lu-Adjust



Failed Lu-Adjust

5. Detection of gamma sources



Direction of maximum response for gamma radiation

To detect hidden gamma sources, it is necessary to use the count rate mode. Thus the instrument reacts much more quickly to suddenly changing pulse rates than the dose rate mode. The value set for the alarm threshold is either a fixed alarm threshold being slightly higher than the occurring display values observed over a longer period of time or a sigma threshold, amounting to 4 to 6 sigma according to the false alarm frequency desired. Subsequently, the operator passes the object while keeping thereby the distance between the monitor and the object to be checked as small as possible.
With an alarm occurring, the operator should move the instrument while observing the display in order to localize the position of the source. Please note that the alarm can occur up to one or two seconds after passing the nearest distance to the

source. Please refer to chapter 1 for the detection of neutron sources.

5.1 Background

During operation in count rate mode with sigma ≥ 2 the background radiation is always monitored and a smoothed, low-pass filtered value is computed. This value, limited to 100 cps, is used for the calculation of Alarm 1 if the sigma alarm is activated. During sigma alarm the monitoring of background is suspended.
On acknowledgement of an alarm 1, the background ratemeter is set to the actual count rate and background learning continues.

5.2 NBR (natural background rejection)

For this additional feature the ratio between the detected gamma energies is used to indicate unusual radiation conditions. Three energy channels for low-, mid- and high range energy are monitored and compared with three thresholds. If the channels exceed the adjustable (via PC-program) thresholds, an alarm is released and it appears a message “LOW Ener.” for low energy radiation, “MID Ener.” for midrange energy radiation respectively “HIGH Ener.” for high energy radiation, in the top line of the normal display. The alarm tone and vibrator can be acknowledged by a short key depression. The NBR-indicator can be activated by the menu function or the PC-program RadEye.exe.

The purpose of this additional alarming algorithm is to allow the setting of a significantly lower detection level (compared to the gross count rate alarm) for a vast number of artificial gamma isotopes: Especially in an urban environment the background count rate varies from a few cps up to 60-100 cps (~20 µR/h natural gamma background). Thus operating on an Alarm 1 level of less than 40 cps, natural background variations can cause a lot of annoying false alarms. Using the NBR feature however, radiation fields with an energy distribution that is sufficiently different from the natural environment can trigger an alarm at 20 cps or even below.
A typical detection limit for a background of 0.05 µSv/h (5 µrem/h) is about 0.004 µSv/h (0.4 µRem/h) for Am-241 and 0.008 µSv/h (0.8 µrem/h) for Co-57.
Fast initial alarm indication is achieved by the automatic adjustment of the Alarm 1 gross counting level according to the 5 – 6 sigma setting (if the set minimum value is exceeded).

The following list shows the expected response to a number of radioactive sources.

Low energy:
Tc-99m; Cd-109; I-125; Xe-133; Ce-141; Ce-144; Sm-145; Nd-147; Pm-147; Gd-153; Re-186; Re-188; Ta-182, Am-241 (strong shielded source may be recognized as “High energy”)

Low energy / Mid. energy:
Co-57; Sn-117m; I-123; Lu-177; Tl-201; U-235

Mid. energy:

Be-7; F-18; P-32; Cr-51; Fe-52; Cu-61; Cu-64; Cu-67; Zn-62; Ga-66; Ga-67; Ga-68; As-74; Se-75; Br-75; Br-77; Rb-83; Kr-85; Sr-89; Sr/Y-90; Pd-103; Ru-103; Ru/Rh-106; In-111; Sb-124; Sb-125; I-124; I-126; I-131; Ba-133; Xe-127; Cs-134; Ba-140; Tb-149; Lu-176; Hf-181; Ir-192; Pb-203; Ac-225; Ac-227; U-233; Np-237/Pa-233; Pu-239; Pu-240

Mid. energy / High energy:

Na-22; Co-55; Cu-60; Ga-64; As-72; Y-86; Zr-89; Mo-99; Sb-127; Cs-137; Bi-207

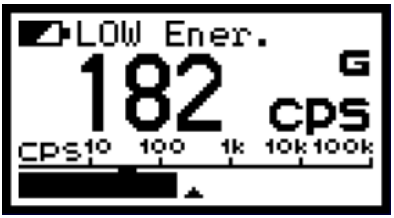
High energy:

Mg-28; K-40; Ca-47; Sc-46; Mn-52; Mn-54; Mn-56; Fe-59; Co-56; Co-58; Co-60; Zn-65; Y-88; Zr-95; Ag-110m; Eu-152; U-238/Pa-234

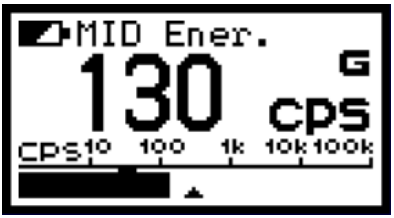
Balanced:

Background; Ra-226; Th-228; Th-232

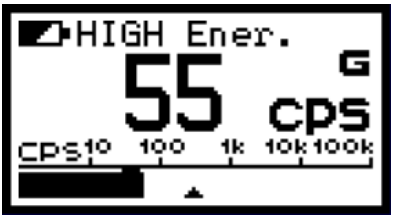
Alarm displays with activated NBR alarm:



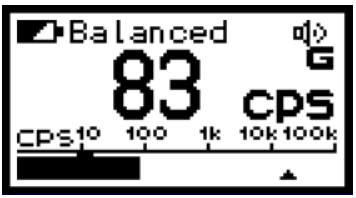
Man-made radioactivity with main energies up to approximately 150 keV.



Man-made radioactivity with main energies up to approximately 600 keV.



Man-made radioactivity with main energies above 600 keV



Natural radioactivity (NORM-Material)

6. Indication of neutron sources

The RadEye SPRD does not contain a specific thermal neutron detector, but uses specific characteristic features of the measured gamma spectrum to indicate the presence of a neutron source. Thus the RadEye SPRD does not meet the alarm sensitivity requirements for neutron radiation according to ANSI 42.48, but indicates the presence of neutron radiation once a source had been detected via the emitted gamma radiation. This feature is particularly important to quickly indicate and distinguish neutron sources from other less relevant radioisotopes, i.e. small shielded AmBe or large shielded Am-241 industrial sources, as well as industrial Cf-252 sources that may not be properly identified by conventional gamma only pagers.

Please note, that unlike to neutron pagers containing a detector for thermal neutrons, the capability of the RadEye SPRD to indicate neutrons is not significantly reduced, once the pager is taken out of the holster. The RadEye SPRD should be placed as close as possible to the source (but not exceeding the recommended count rate of 5000 cps for nuclide identification).

Factory default and recommended setting for the dual (gamma neutron) display is “disabled”. Via RadEye.Exe, this setting can be changed to “enabled”. The neutron count rate alarm and message at the end of a nuclide ID are both set to “enabled”.

For operation in altitudes exceeding 1000 m, the Neutron alarm level in the ratemeter mode and the neutron alert level for the ID may need to be adapted.
E.g. in 2500 m values of 0.7 cps for the ratemeter and 0.2 cps for the ID are recommended.



Neutron alert in ratemeter mode



Neutron alert as ID-Result

7. Functional test

The radiation meter performs continuous self-check routines. A complete failure of the detector will be detected in 20 s and will be indicated on the LCD and be announced by the beeper. The same applies to the battery voltage.

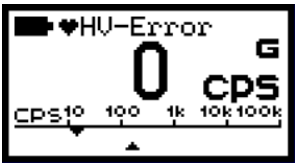
7.1 Functional test

To carry out a simple test, shortly press any key for two times. The first key press turns the backlight illumination on without any other action. With the second key stroke a short audible pulse has to be released (if not disabled via PC configuration).

The heart symbol next to the battery indicator must be “beating”. This indicates that the cyclic tasks as calculating measurement values and checking for alarm thresholds are active.

7.2 Failure indication

In case of a failure or if the battery voltage is low, the beeper generates a tone sequence every 30 s.
The corresponding failure message is displayed in the LCD:



Error high voltage generation



No detector pulse within 20 seconds



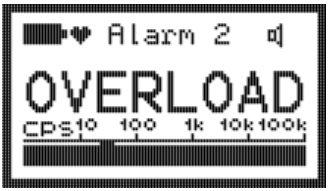
EEPROM with calibration data shows EEPROM Read or EEPROM Write error.



A Watchdog Error indicates that the micro controller has problems to work on its tasks in a given timeframe. Reasons are strong electromagnetic pulses, firmware errors or hardware issues.

7.3 Overload indication

On dose rates of more than 25 mR/h (250 µSv/h) an overload indication is given:



The dose value is marked with an overload indication, if a dose rate overload occurred since the last dose reset.



Neutron count rates of more than 2000 cps lead to a neutron overload. Both overload messages of the neutron and the gamma channel can be displayed by the RadEye SPRD:



7.4 Temperature warning

The maximum temperature of the RadEye SPRD is 50°C (122°F). If the temperature higher than 50 °C the RadEye shows the following screen:



By pressing the right button, the user may switch off the Rad-Eye to avoid false alarms.

With a key stroke on the left button the RadEye continue with the operation and a rolling warning message is displayed in the top line:

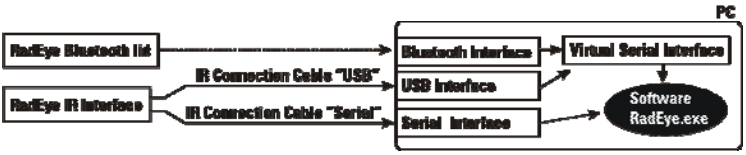


8. PC configuration

The configuration of the RadEye SPRD via Windows software requires optional Thermo Scientific hardware and software.

8.1 Ways to connect to a PC

A RadEye unit can be connected to a PC either by serial interface, USB interface or by Bluetooth ™ [2].



8.1.1 Wireless connection via Bluetooth

Details about the Bluetooth communication are provided through the manual DB-076 E delivered with the optional Bluetooth battery cover. Please note that the connected PC must be equipped with a Bluetooth interface as well.

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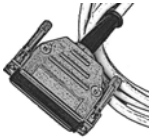
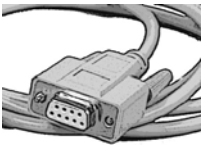
2 Bluetooth is a trademark of Bluetooth SIG, Inc., Bellevue, Washington, U.S.A.

8.1.2 Cable connection

It is recommended to use the optional RadEye desktop holder to align the RadEye's IR window with the IR window of a connection cable.

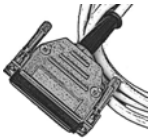


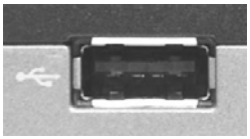
The optional serial adapter cable is used to connect to a RS232 port of a PC.


This serial port is selected directly in the RadEye.EXE software (see also chapter 8.3.4).

Alternatively, the optional USB connection cable is used to connect to an USB port.





Using the USB connection requires the installation of driver software that will generate a virtual serial port that can be selected in the RadEye.EXE software. The driver is delivered on the RadEye.EXE software installation CD ROM.

Installation of a connection cable

Using the hardware provided and without exerting too much force and attach the connections of the adapter cable to the PC and to the RadEye desktop holder.



8.2 Installation of the optional RadEye.EXE software

Open the file “Setup.EXE” on the optional RadEye.EXE Software installation CD Rom and follow the installation guideline. The installation generates a RadEye.EXE Icon on the desktop.

8.3 Start RadEye.EXE

Once the RadEye.EXE program has been started, device parameters are displayed on the screen.

8.3.1 RadEye SPRD Device Parameters

The Frame "RadEye SPRD" contains the unit's serial number and version number of the software. Click on the Read button, the Parameters of RadEye SPRD will be read out from the device and shown in the Frame.

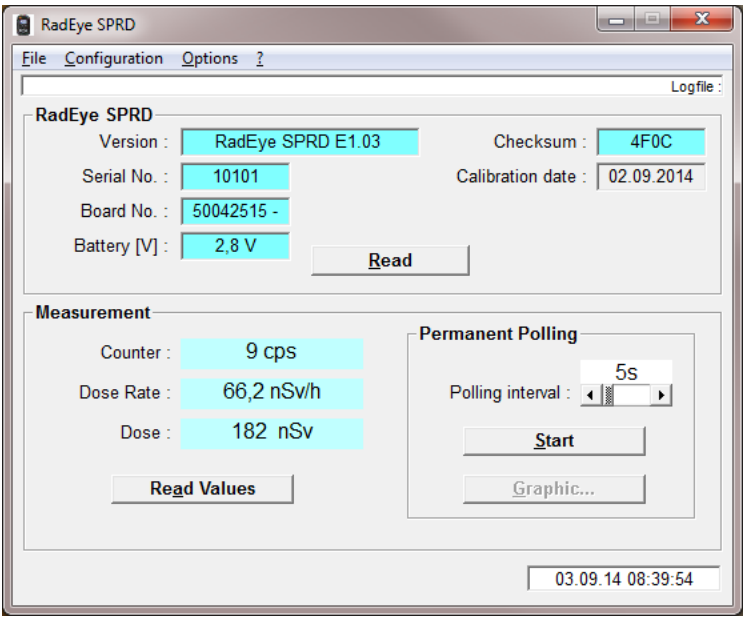


Figure 8-1: Main Window

8.3.2 Measurements

After pressing the button “Read Values” the current Count rate, dose rate and dose are displayed in this frame.

With button Start the measured value is read from the unit at a certain polling interval. Use the scroll bar or the buttons beneath the "polling interval" field to define the polling interval. You can select a value between 1 and 3600 seconds.

The counter and the dose rate can be displayed numerically and graphically. Click on the “Graphic….” Button. A diagram is displayed that gives a representation of the counter and dose rate values versus the time.
The current measured value is added at the right-hand side, and the diagram is shifted to the left. Up to 100 measured values can be represented. The graduation of the ordinate is automatically adjusted to the measured values supplied by the unit.

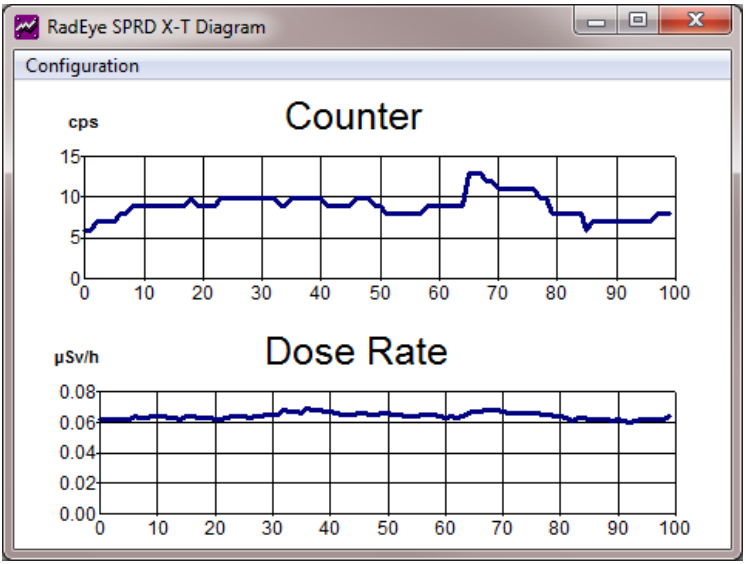


Figure 8-2: Measurement graphics

8.3.3 Creating a Measurement File

The actual measured values Count rate and Dose rate that are shown in the "Measurement" display field can be stored in a measurement file.

To do this, open the File menu, click on **Open Logfile...**, and enter path and name. The file is stored with the file name extension ".log".

If another file of the same name exists, the system asks whether that file shall be overwritten or the new measured data shall be appended to the existing data.

Once you have pressed OK to confirm the entries, the measurement logfile is created and the polling measured data is stored in the scan interval you have defined. An open measurement file is indicated by the name and the path of the measurement logfile that appears in the top right-hand corner of the window.

To terminate data storage, open the File menu and select the **Close Logfile** menu item. No further data is recorded.

Open the **File / View Logfile...** menu to view the measurement logfile.

For training and demonstration a prior recorded logfile can be replayed by opening **Replay logfile**.

With the buttons Start and Stop together with the polling interval the replay can be controlled.

Close Replay switches back to accessing measurement values via infrared interface.

The measurement logfile is an ANSI text file with columns that are separated by <TAB>. This enables this file to be read easily into other programs (such as Excel) where the data can be processed.

The first line of the measurement logfile contains the unit name, the file name, and the path. Serial number and Device identification are specified on the second line.
Date and time of the measurement are specified in the columns under the field names "mm.dd.yy" and "hh:mm:ss". The time setting corresponds to the PC system time.

The "Counter" column contains the numerical value of the counter measurement. The "Unit" column informs about the unit. The "Dose Rate" column contains the numerical value of the dose rate measurement. The "Unit" column informs about the unit (Sv/h or R/h).

8.3.4 Select serial interface

Via **Configuration / Com settings**... menu another window is opened from which you may select the corresponding interface. An error message is displayed if the interface is not available.

8.4 Configuration

On the **Configuration** / **RadEye SPRD…** menu, the following parameters can be modified:

- Operating mode
- Unit
- Basic display
- Time interval of the history
- Acoustic indication
- Alarm level for all basic displays
- Signaling types
- Additional surveillances
- active menu functions

8.4.1 General configuration

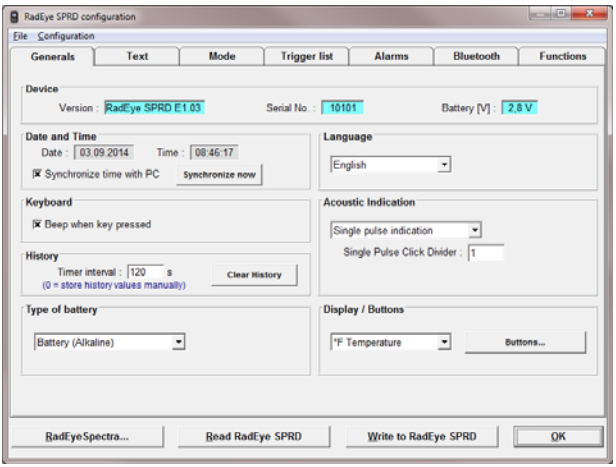


Figure 8-3: General configuration

On the “Generals“ tab, the user may set menu language, the time interval for the history memory (1...43200s), the acoustic rate indication (single pulse, finder, 4.2) the type of battery (4.8) and temperature unit (°C or °F).

Furthermore the assignment of keys can be configured:

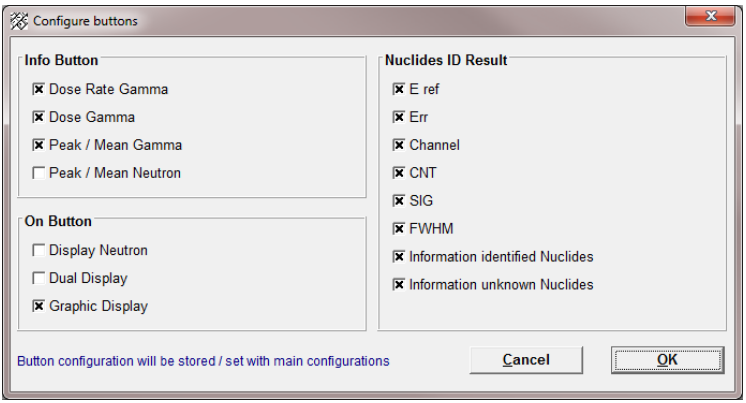


Figure 8-4: Button configuration

The frame “Info Button” configures the assignment of the “▲/Info” button. See also chapter 3.1.2.
The frame “On Button” configures the assignment of the “▼/On” button. See also chapter 3.1.3.
The frame “Nuclides ID Result” configures the assignment of the “▼/On” button for the result screen after ID measurement. See also chapter 3.3.3.

8.4.2 User defined text

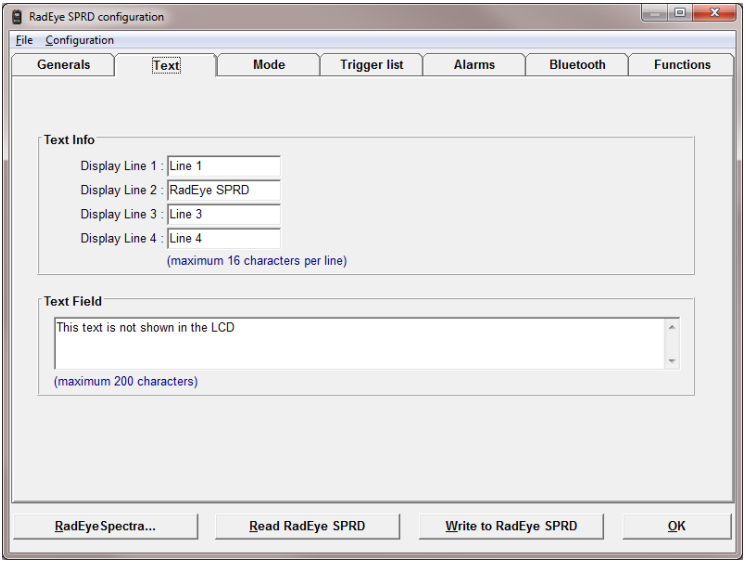


Figure 8-5: User defined text

On the tab “Text“ it is possible to store a text in the RadEye. In the field “Text Info“ the user can define 4 lines text, which can be displayed on the LCD by the RadEye.
In the “Text Field“ it is possible store a text with up to 200 characters in the RadEye. This text can not be displayed by the RadEye.

8.4.3 Mode configuration

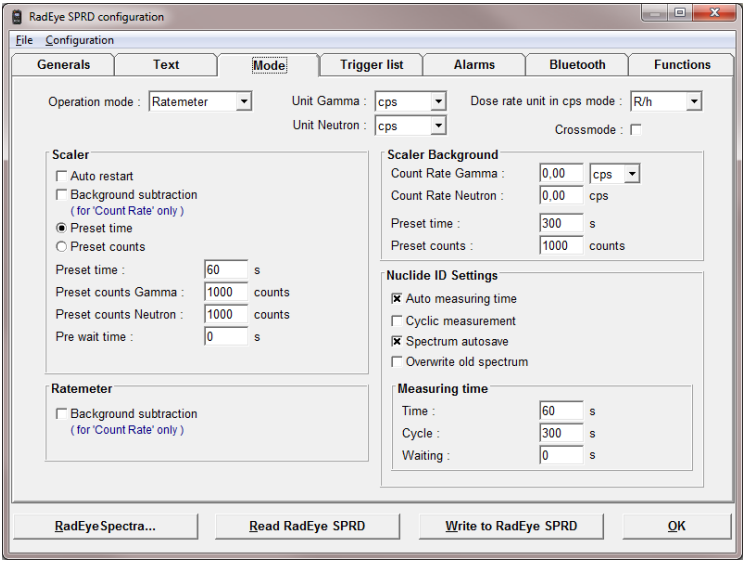


Figure 8-6: RadEye mode

On the "Mode" tab, the user may set the operation mode, the physical units and parameters for scaler measurement. Furthermore the following parameters for Nuclide ID measurement can be modified:

- Auto measuring time: if active, the RadEye calculates the measuring time based on count rate
- Cyclic measurement: with this option the RadEye performs a periodic measurement. Please note: the cyclic measurement time must be greater than the measuring time. It is recommended to disable the auto measuring time option.

- Spectrum Autosave: if active the spectrum will be saved automatically after ID.
- Overwrite old spectrum: if memory is full old spectra will be overwritten without user request.
- Measuring times for
  - Fixed time setting (auto measuring time is disabled)
  - Cyclic measuring
  - Pre-waiting time

8.4.4 Trigger list

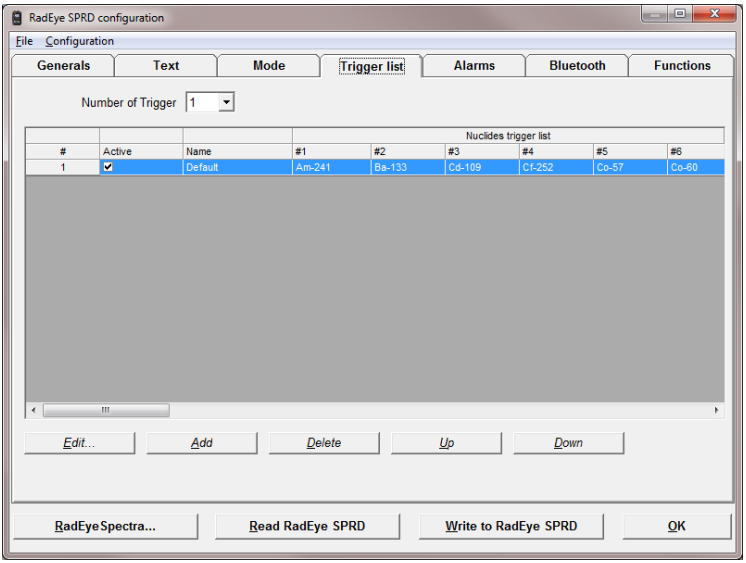


Figure 8-7: Trigger list

Here the user can manage the trigger list, used for nuclide identification.
“Add” and “Delete” is used to add and delete entries in the trigger list.
“Up” and “Down” move the entries in the trigger list.

“Edit…” opens another window where the nuclides can be managed.

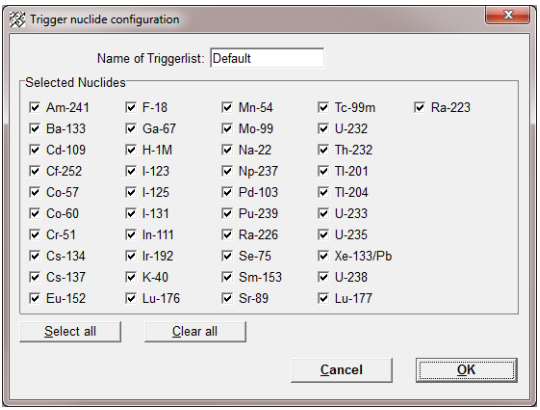


Figure 8-8: Edit nuclide trigger list

8.4.5 Alarm configuration

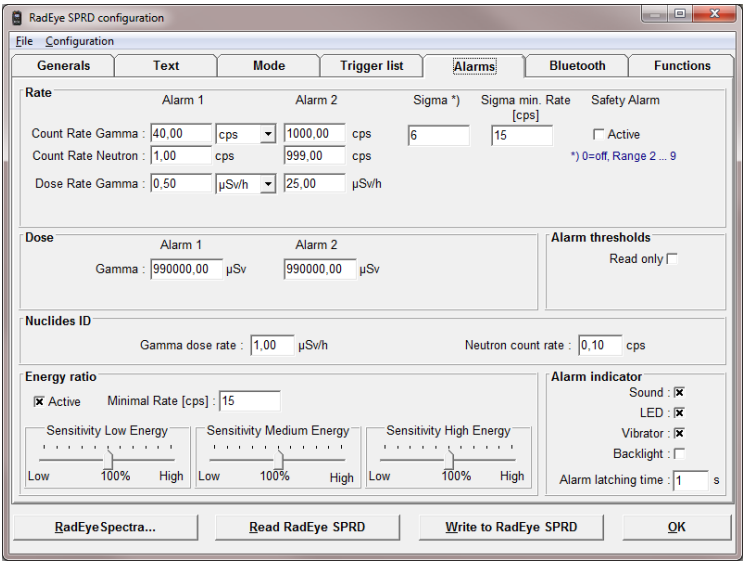


Figure 8-9: Alarm setting

The “Alarm“ tab offers the user the possibility of making the alarm settings for the single basic displays. Furthermore, the options on this tab allow beeper and additional alarm monitoring processes to be configured.
If the RadEye SPRD is mainly used as an alarm device wearing at the belt, it is recommended to set an alarm latching time of 10s. This is useful to notice short exposure events.
The software control of the energy ratio sensitivity allows a fine tuning of the NBR-alarm (see chapter 5.2).

8.4.6 Bluetooth configuration

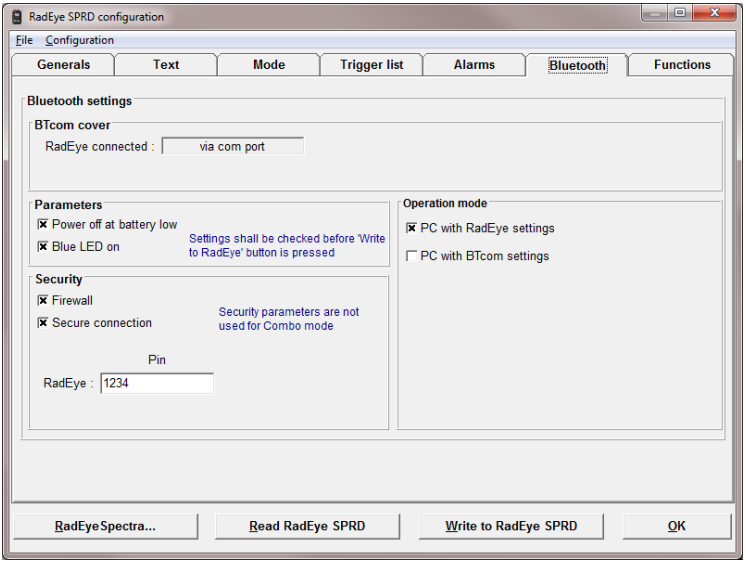


Figure 8-10: Bluetooth configuration

Here the user may configure the BTcom battery cover. The frame “BTcom cover” informs about firmware version, serial number and the physical address of the BTcom cover (not the RadEye). This information is only visible, if the RadEye is connected via Bluetooth.
The Parameter “Blue LED on” relates to the blue LED at the backside of the battery cover that shows the connection status. Setting “Power off at battery low” the BTcom cover powers down automatically if battery low status is detected to increase battery life of the RadEye. “Secure connection” uses the PIN code that can be edited in the right field.
For more information please read the manual which is delivered together with the BTcom cover.

8.4.7 Menu configuration

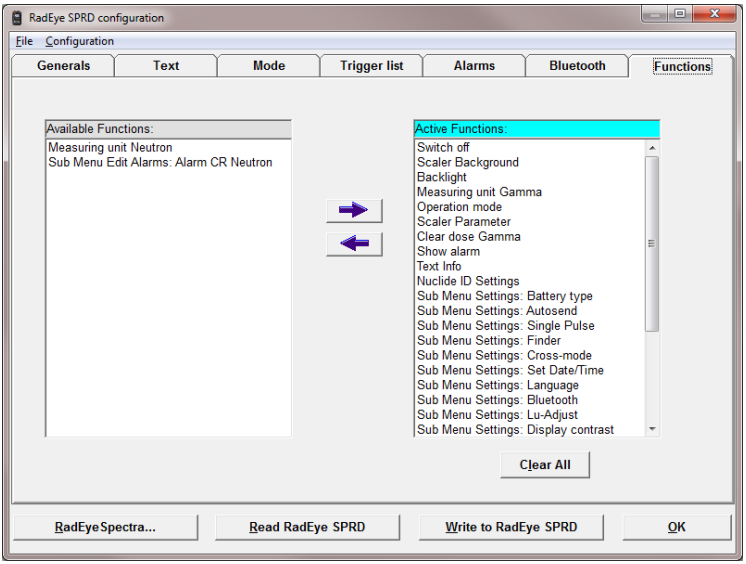


Figure 8-11: Menu selection

On the “Functions” tab, the functions available to the user can be selected to speed up access to frequently needed functions. For example, if LED alarm is always active and Autosend is never used, these functions can be hidden for the user.

Once the setting of the parameters is finished, the configuration is sent to the RadEye SPRD by clicking on the “Write to RadEye SPRD” button.
Parameters including the selected menu configuration can be saved with **File / Save as…** as parameter file (*.cfg). A saved configuration can be reloaded using the menu **File / Open…** and sent to RadEye SPRD.

8.5 History

Via the **Options** / **History** menu, the values stored in the RadEye SPRD data memory can be read out, represented in an x/t diagram and saved to the hard disk of the computer. These data subsequently can be read in and further processed in a spreadsheet program.

Time interval of History storing can be set from 1s to 43200 s (12 hours). 1600 measurement values can be stored.

The RadEye unit loses its date and time settings if the power supply is interrupted (battery exchange). Therefore also the date and time stamps of the history data can be affected, if the date and time information is not updated immediately.

The blue line shows the mean values, the red line the maximum value within the time interval.
If batteries are removed, the time reference is lost. In the diagram time information is only provided for history values with valid timing en-

tries.

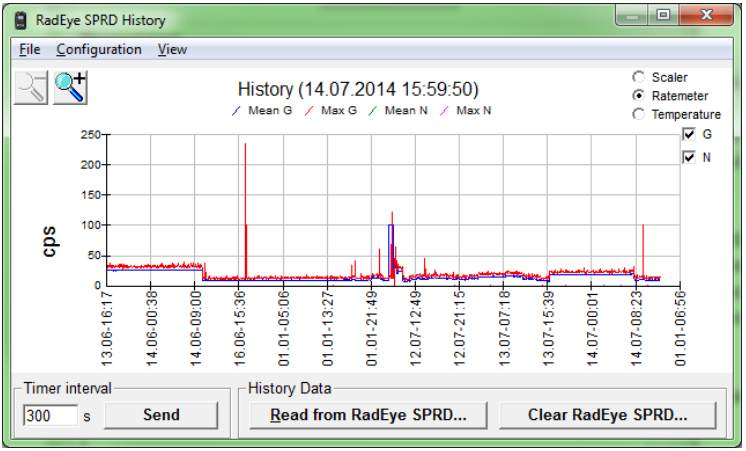


Figure 8-12: History read out

Clicking at the graph, each individual, stored measured value can be displayed:

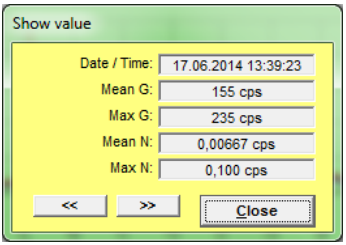


Figure 8-13: Single history value indication

8.6 Logbook

Changes in configuration, occurring alarms and errors are logged in a buffer.
These saved events can be read out via **Options / Logbook…** .
The logbook is shown as a table, and can be saved to PC hard disc or printed.

The logbook has a maximum of 250 data sets. Several events at the same time are saved as one record. At the display every event is shown in one line for better overview. The date and time of the PC is used for time relation.

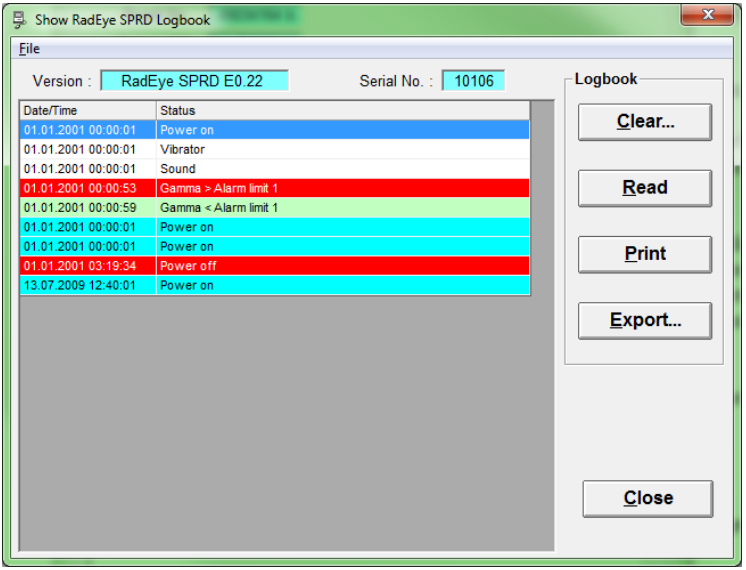


Figure 8-14: Logbook

8.7 RadEye Spectra

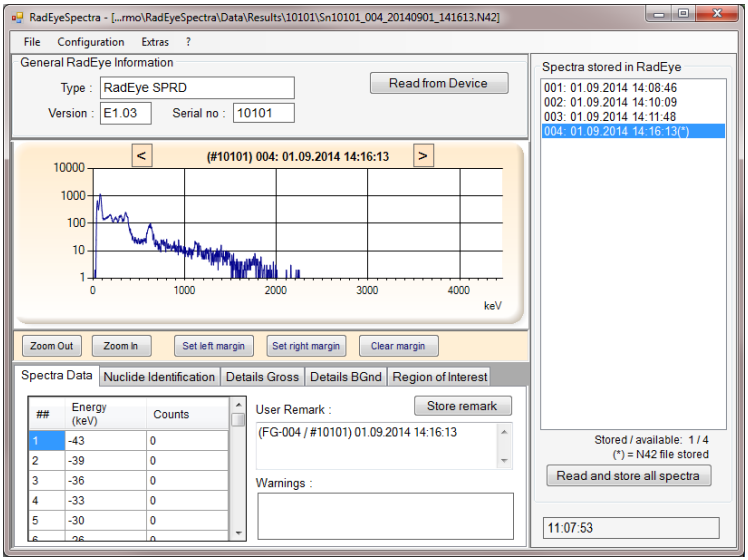


Figure 8-15: RadEye Spectra

This optional available pc program is used to read out the spectra stored in the RadEye. The button “Read from RadEye” reads the time stamp of all stored spectra. A click on the time stamp starts the read out of the spectrum. The data is automatically stored on the hard disk in ANSI N42.42 (2012) XML format.
The upper part of the window displays the spectrum graphically. The lower part of the window shows the details of the spectrum. Furthermore the user can add some more remarks.

“Read and store all spectra” is used to read out all spectra stored in the RadEye.

8.7.1 Storing spectra to another location

By means of "File / Save As…" menu function the user can copy the currently loaded N42 spectrum file to another location.

8.7.2 Loading spectra from file

By means of "File / Load…" menu function the user can load a stored N42 spectrum file. This spectrum and its referring values are displayed. The referring background spectrum is loaded together with the gross measured spectrum if a background spectrum was used in the RadEye at the time of storing.

8.7.3 Export spectra data

By means of "File / Export spectrum…" menu function the user can export the currently loaded N42 spectrum file as text file which can be imported in data spreadsheet programs (e.g. MS Excel).

9. Trouble Shooting

9.1 RadEye SPRD doesn't power on

9.1.1 Press "On" for at least one second

Keep the button "▼" pressed until the LED and the sound is active. The RadEye may need a longer time for start up if it is started immediately after the batteries are inserted. If the button is pressed only shortly, then the start up routine is not activated. The LED may flash then only very shortly.

9.1.2 Check battery

If the RadEye SPRD does not respond to a long press (> 1s) of the "▼" button, then please use the following step by step procedure:

A) Remove the current batteries

B) Clean the battery contacts

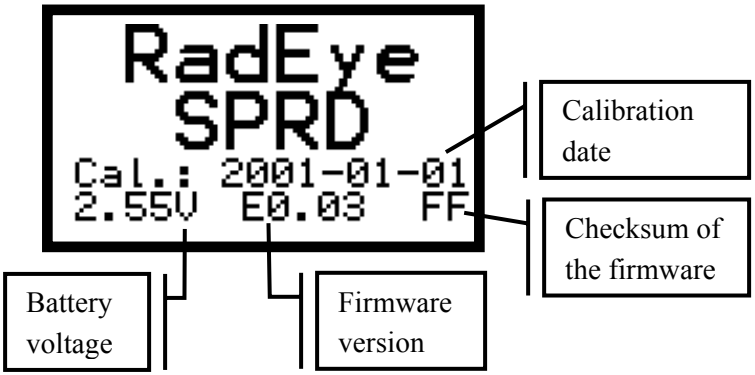
C) Check the required orientation of the batteries according to the printed "+" symbols in the battery compartment.

D) Insert two -"AAA" with sufficient capacity: Rechargeable AAA batteries should be completely loaded, non rechargeable batteries should supply together at least 2.3 Volt under load.

E) Press the "▼" button for more than one second (see also 9.1.1)

9.2 Reading data from the start up screen

The startup screen shows important data like the last calibration, the current battery voltage and the firmware version.



This screen stays active as long as the "▼" button is kept pressed during the power-on of the RadEye device.

9.3 The RadEye doesn't show the menu items as described in the manual

The items available in the RadEye SPRD's menu can be disabled or enabled via the RadEye.EXE software. The factory setting has all menu functions enabled. Please refer to chapter 8.4, menu settings. Next, please check the firmware version of your RadEye SPRD (see chapter 2.4) and compare your version number with the revision table of this manual at the beginning of the document. The revision table shows the introduction of new functions together with the according firmware version.

9.4 The RadEye shows an error message in the display's top line

Please refer also to chapter 7.2. If one of the following failures is indicated, then the instrument must be repaired by the Thermo Scientific bench repair team:

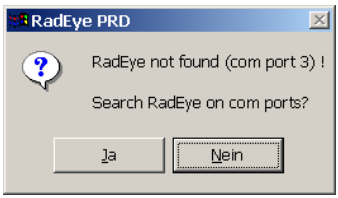
```
HV-Error
Detect Err
EEPROM Err
Watchdog*
```

Please contact our Customer Service for more details.

*) Please see the failure description in the above referenced chapter. If the failure was related to a strong electromagnetic pulse scenario and the failure went away afterwards, then a repair may not be necessary. A diligent observation of the RadEye SPRD proper operation after the failure is strongly recommended.

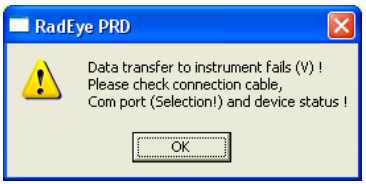
9.5 The RadEye is not found in the software

If the connection between the RadEye and the computer can't be established with a selected serial port (COM port), then the program shows the bellow message first:



The RadEye.EXE software offers to search for a connection to the RadEye unit on other available serial ports.

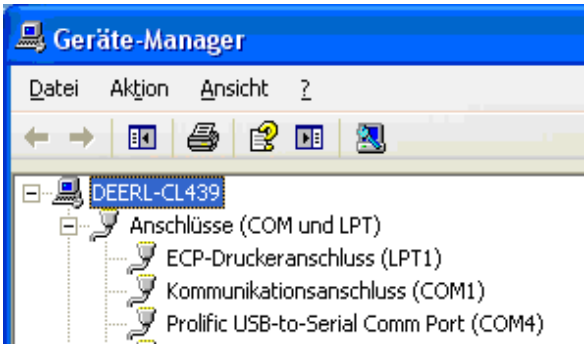
If there is a faulty connection between the unit and the computer, the program shows the error message “Data transfer to instrument fails”



In this case, you must check whether:

- The RadEye has been positioned correctly in the desktop holder (with rubber boot) and the RadEye is turned on.
- The infrared transmission windows are clean
- The correct serial interface has been selected.

It is recommended to use the Windows system tools to determine the occupation of the currently active serial ports. Virtual serial ports are labeled accordingly for identification.



Device Manager showing the virtual driver
for USB „Prolific“ at COM 4

Open next the serial interface step window in the RadEye.EXE software: **Configuration / Com settings...** menu. The used serial port has to be selected next.

9.6 RadEye lost date and time settings

The date and time information is lost, each time the batteries are removed or below the required voltage for operation. The simplest way to program the date and time is to use the “synchronize” function of the optional RadEye.EXE software. Else the current date and time can be set also through the RadEye’s menu “Settings” / “Set Date / Time”.

9.7 RadEye's battery status is lower than expected

Please check if the correct battery type is selected under "settings" / "Batt. type" and change the type in case. Rechargeable batteries supply a voltage of 1.2V each, while Alkaline batteries provide 1.5V.

Rechargeable batteries offer also a more steep drop from acceptable battery voltage to "battery low" than Alkaline types.

9.8 History data shows the wrong time and date

See chapter 9.6.

10. Maintenance

10.1 Recommended maintenance

The RadEye SPRD is basically maintenance free.

10.1.1 Lu-Adjust

It is recommended to perform a Lutetium test routine (Lu-Adjust) with the optional Lutetium test adapter on a regular basis. The Lutetium test routine is described in chapter 4.9.

Level of usage	**Period between Lu-Adjusts**
Intensive, changing climate	3 month
Normal, daily usage	6 month
Low	12 month

10.1.2 Cleaning the instrument

The rubber boot should be removed and cleaned separately. The RadEye unit shall be cleaned with a moist tissue (only water as cleaner). The rubber boot shall be washed in water. Do not use aggressive chemicals like organic solvents.

10.1.3 Remove batteries for storage

It is highly recommended to remove both AAA batteries from the battery compartment, if the RadEye unit is stored for a longer period (> 1 week) to avoid damage through battery leakage.

11. Spare Parts

11.1 Available spare parts

Item	Part Number
Front foil RadEye SPRD engl.	425067030xx
Battery cover complete	425067033
Rubber shock protection (rubber boot)	42506703018
Battery IEC-LR03 Micro 1,5V ENERGIZER E92 (1 pack = 2 batteries)	SM164600012

11.2 Recommended spare parts

Battery IEC-LR03 Micro 1,5V ENERGIZER E92 (1 pack = 2 batteries)	SM164600012

12. Optional Accessories

12.1 RadEye Holster (425067046)

The clip at the backside of the holster allows convenient carrying of the RadEye at the belt.



RadEye not included

12.2 Earphone for RadEye series (425067037)

The usage of the earphone is recommended, if the RadEye is switched into FINDER mode and disturbance through noisy environment shall be compensated.



The earphone is plugged into the RadEye's socket at bottom of the unit. The cable length is 1.2m.

12.3 Lutetium Test-Adapter for RadEye (425067071)

The 36g contained Lutetium-oxide provides a net count rate of approx 100 cps, if the adapter is attached to the backside of the RadEye. The shape of the adapter ensures that the Lutetium material is placed close to the reference point of the RadEye unit. A cost effective 6 g Lu-Test adapter is also available (42508/1029), but adjustment and test takes much more time.



Please see chapter 4.9 and chapter 10.1.1 about the usage of the test adapter.

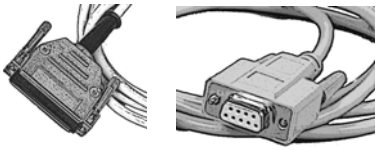
12.4 Desktop holder (425067060)

Alignment between the RadEye's IR data interface window and the IR interface of a PC connection cable is insured with the usage of the desktop holder. Please see chapter 8.1.2 for details.



12.5 IR connection cable serial (4254029)

The IR plug of the connection cable can be fixed easily by screws at the desktop holder. The PC connection plug is a 9 pin sub D type for serial COM ports.



Please see chapter 8.1.2 for details. Cable length = 1.2 m

12.6 IR connection cable USB (4254026)

The IR plug of the connection cable can be fixed easily by screws at the desktop holder. The PC connection plug is a 9 pin sub D type for serial COM ports.



Please see chapter 8.1.2 for details. Cable length = 1.2 m

12.7 Bluetooth battery cover (425067087)

The standard battery lid is replaced with the Bluetooth battery cover. Please see chapter 8.1.1 for details.



12.8 RadEye car- and wall holder with accumulator charging circuit

Safety instructions

1. Only use NiMH – accumulators, no primary batteries (Alkaline –manganese, zinc – carbon ...)
2. Only use two accumulators of the same type (manufacturer, rated capacity ...)
3. Only charge accumulators having the same discharging state
4. Never use defective accumulators (penetrating/emerging electrolyte, damaged housing...)



RadEye car holder : 42506/7065

The RadEye car holder 42506/7065 serves as supporting device and power supply unit for the operation of a RadEye instrument in a vehicle. For convenient mounting to the dashboard one of the mechanical adaptors 42506/7061 ... 64 is required.

Together with a power supply unit 42506/7066, this support is also suitable for a cost attractive stationary ambient monitoring.
Via the alarm contact, power consuming external alarm indicator can be operated.

The RadEye car- and wall holder combines several functions.

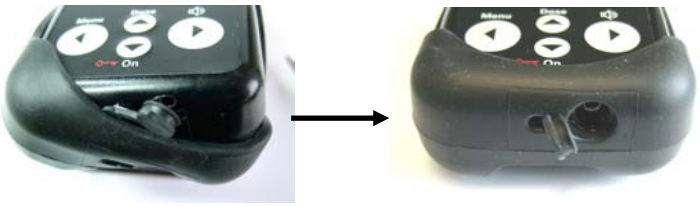
(1) Mechanical holding device for instruments of the Rad-Eye-family
(2) Accumulator charger unit with temperature controlled charging of NiMH accumulators in the device
(3) Infrared interface for direct connection to the serial interface of computers
(4) Alarm contact for connecting alarm indicators up to a power of 24W (at 24V, see RadEye area monitor 42506/80)

Before plugging the RadEye into the Car holder the rubber protection plug at the phone jack has to be opened:

- Carefully remove the protection sleeve and open the phone jack



- Remount the protection sleeve (see chapter 2.3). A small screw driver for the protection plug might be helpful. The phone jack must left be open, and the protection plug must be perpendicular to the protection sleeve.



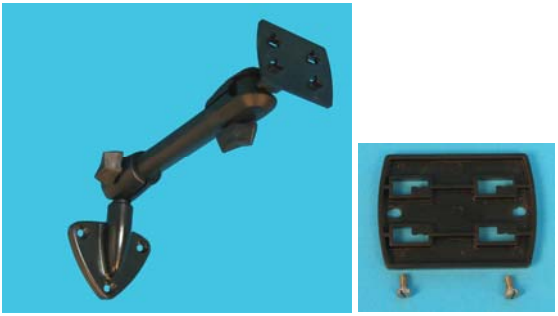
- Then insert the RadEye into the car holder. Make sure that the protection plug is not mechanically interfering with the charging pin of the car holder.



12.8.1 Accessories for dash board mounting of car holder 42506/7065 (including charging function) holder 42506/7060 (mechanical holder only)



Goose neck adaptor kit 42506/7061



Pivot arm adaptor kit 42506/7062




Knuckle joint adaptor kit 42506/7063




Goose neck adaptor kit with suction cup 42506/7064

12.8.2 Accessories for data transmission using the car adaptor



RS232 connecting cable 2m: SM1685 35223



USB 1.1 to RS232 adapter cable: SM1685 35251

USB 2.0 to RS232 adapter cable: SM1685 35255

12.8.3 Accessories for AC – operation of the car adaptor



Power supply with cigarette lighter socket 42506/7066 for mains operation of the car holder 42506/7065

12.9 RadEye Area Monitor with alarm contacts (4250680)

A RadEye SPRD can be used as installed radiation monitor if used as RadEye Area Monitor. The RadEye is permanently powered and the alarm status is visible as light and with further accessories also as sound alarm (425068010). More information is provided in the manual DB-062E.



12.10 Foodmonitor (425069015)



Using the extremely compact and portable sample changer assembly, the typical background is reduced by up to 90 % and thus samples of up to 180 ml can be measured for low activity contamination.

13. Technical data

13.1 RadEye SPRD

Radiation type:	RadEye SPRD: Gamma radiation, neutron radiation RadEye SPRD-HR: Gamma radiation
Measured variables:	Gross count rate [cps], [cpm] Ambient equivalent dose rate: $\dot{H}^*(10)$ [Sv/h], [rem/h], $H^*(10)$ [Sv], [rem] Within the RadEye SPRD the relation 1 R = 1 rem =10 mSv is used.
Measuring range:	Gamma: 250 µSv/h [25 mrem/h] depending on calibration and photon energy Gamma count rate display up to 50 kcps Neutron count rate display up to 10 kcps
Overload display:	more than 250 µSv/h [25 mrem/h] overload indication up to 10 Sv/h [1000 rem/h]
Linearity error:	max. ± 10 % in the measuring range

Gamma Sensitivity:

Energy (Nuclide)	RadEye SPRD (cps/mrem/h)	RadEye SPRD (cps/µS/h)
60 keV(Am-241)	110	1100
662 keV(Cs-137)	10	100
1250 keV(Co-60)	5	50

Alarm threshold: Independent alarm thresholds for all operating modes.

Audible alarm intensity: 85 dB at a distance of 30 cm

Energy range: 40 keV – 3.0 MeV:
for dose and dose rate measurement

Energy dependence: see Diagram 13-2

Direction of max. response: perpendicular to the device's longitudinal axis, to the reference mark on the back side of the unit

Reference point: on the axis of the direction of max. response, 14 mm behind reference mark.

Detector	RadEye SPRD: ∅12.5 x 31mm CsI
Operating temperature:	-20°C ... + 50°C
Relative humidity:	10 ... 95 %, non condensing
Operating voltage:	1.9... 4.0 V, Battery low voltage starting from 2.2V
Degree of protection:	IP 65 according to EN 60 529
EMC:	Disturbance emission : EN 61000-6-3 Immunity: EN 61000-6-2
Mechanical shock:	Drop onto a concrete surface 0,5m without protection sleeve 1,5m with protection sleeve
Size:	96 mm x 61 mm x 31 mm, without rubber protection
Weight:	around 160 g including two Alkali Manganese AAA cells LR 3 and rubber protection.

Internal memory: The last 1600 measured values are saved and can be read out via PC program. Max- and mean value of count rate and dose rate. The time interval is factory preset to 120 s by default. Logbook with 250 entries for changes of configuration, occurring alarms and errors.

Averaging filters: ADF (Advanced Digital Filter) for count rate and dose rate. Digital RC-Filter with time constant 1s.....100s, depending on count rate and dose rate changing.

cycle time: 0.5s

Background filter type: digital RC- filter. Limited to 100 cps: 64s

cycle time: 1s

For determination of sigma thresholds

NBR-ratio filter type: RC: 10s

cycle time: 1s

Power consumption: ≈ 12mW: normal operation without alarm signals and LCD illumination

≈ 80mW with illuminated LC display

≈ 60mW LED alarm

≈ 185mW acoustic alarm

≈ 80mW vibrator alarm

Battery service life: ≈ 175 h using two alkaline AAA cells
≈ 80 h using 800mAh NiMH battery

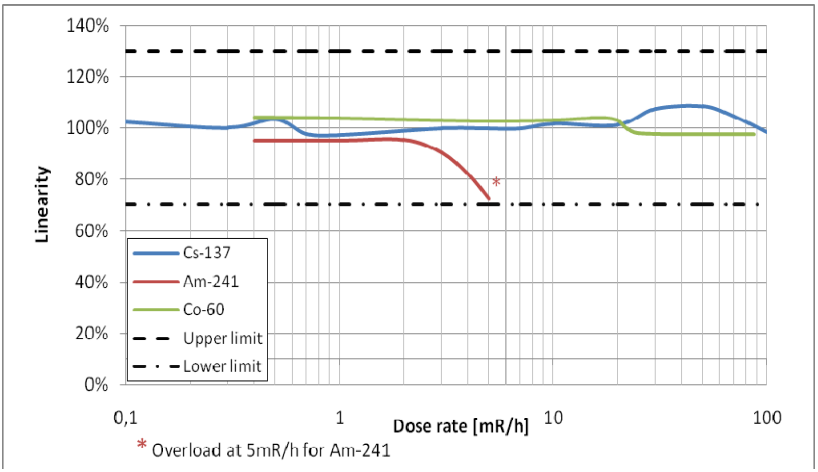


Diagram 13-1: Gamma dose rate linearity of RadEye SPRD

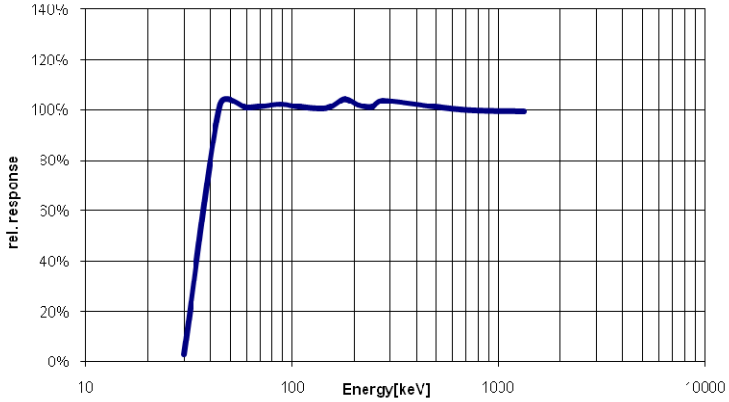


Diagram 13-2: Ambient equivalent dose rate response

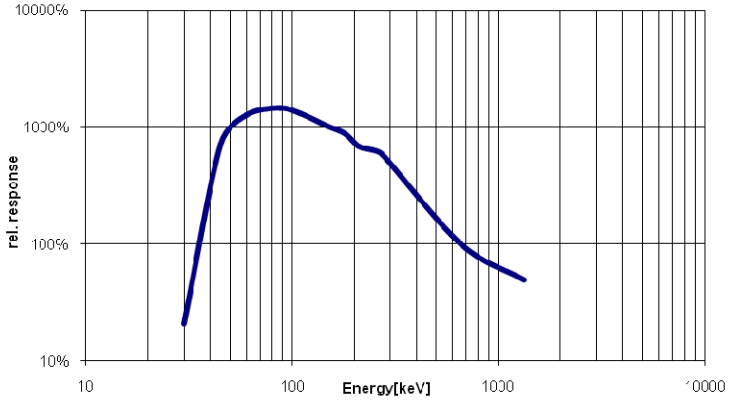


Diagram 13-3: Energy response in main direction count rate

13.2 RadEye car holder

Operating voltage:	8 … 35 VDC
Current consumption:	52 mA from 14 V, RadEye charging
Accumulator charging current:	90 mA
Maintenance charge current:	15 mA
Alarm relay switching current:	1 A, fused
Alarm relay switching voltage:	38 V with overvoltage protection
Alarm relay "On" resistance:	0.22 … 0.33 Ω
Ambient temperature:	-30 … +60°C Operation -40 … +70°C Storage 0 … +40°C Accumulator charge
Degree of protection:	IP50 according to EN 60 529
Size:	80 x 78 x 50 mm
Weight:	140 g

13.3 Firmware version

V 1.00
First edition

V 1.03

- Error correction:
  - Sometimes the acoustic dose alarm could not be acknowledged
  - While ID measurement (after measurement is stopped and started again) the old intermediate result can be seen during the current measurement.
  - Ratemeter mode with dual display: in case of a single Neutron alarm the Neutron measuring value wasn't inverted in the display.
  - The energy line of the detected nuclides are now saved with spectrum data
  - Logbook: multiple entries of identical events is prevented
  - The display of the remaining time if the measuring time was increased by pressing the right button
- Revised nuclide library. Medical nuclides, Th-232 and U-232 are optimized
- The first key press activates the background illumination, without any other action. With the exception of alarm acknowledgement
- Lutetium adjust adapts to the background. Revised user guidance.

- Improved detection of “Bremsstrahlung” and Neutron after ID measuring. The result is saved with spectrum data
- Masking of ID result display. Configuration via radeye.exe
- Display of “Balanced” if no artificial alarm was detected
- Blue LED is flashing if Neutron was detected after ID measurement
- Warning if temperature is over 52°C
- New menu item “Set ID warning” for Neutron count rate and Gamma dose rate
- ID measurement: display of remaining time removed, if automatic measuring time is active
- Function “Send spectrum”: output extended to “NuclideAnalysisResult”

V 1.04

- Error correction: In function “Set ID warning” “Exit” is selected, the sub menu “Edit alarm” is displayed.
- Error correction: If “Low Batt” is detected, a flashing battery symbol is displayed in the result screen
- Revised nuclide list
- Revised Nuclide ID with automatic mode

V 1.07

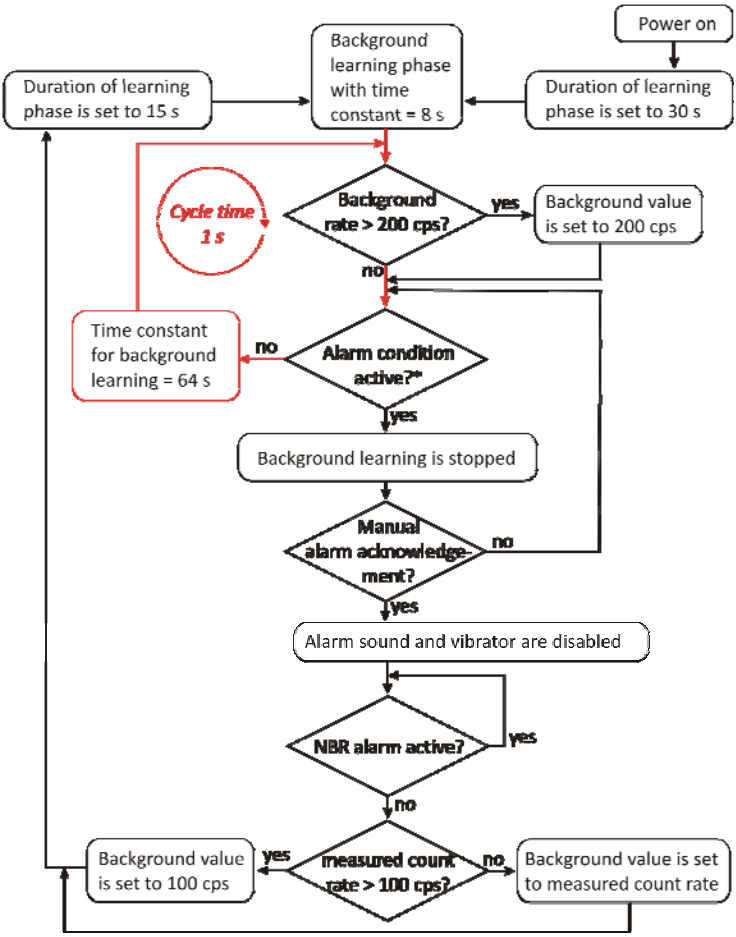
- The firmware verifies that the sequential number of the active trigger list is smaller/equal than the total number of loaded trigger lists.
- Error correction: An extra 160ms job led to higher power consumption
- Crossover Mode revised
- Problems with repeated starting and stopping an ID measurement eliminated.
- Function “send spectrum”: Energy output in ascending order
- Measuring background spectrum with fixed measuring time. Measuring time: 300s.
- Error correction: RadEye asks to overwrite a spectrum. A key press on “Yes” didn’t save the spectrum.
- Error correction with scaler background measurement: the configured pre waiting time was ignored
- Revised rated Alarm.
- Revised dead time calculation during ID measurement

14. Annex

14.1 Interrelationship between false alarm probability and sigma value

Sigma	Threshold at 10 cps background	Mean time to false alarm in seconds	Mean number of false alarms per working day (8h)
2	15	22	1310
3	18	370	77
4	21	16000	1.7
5	24	1000000	0.03
6	26	In practice, there are almost no false alarms at a constant irradiation	
7	29		
8	32		
9	35		

14.2 Flow Diagram Background Learning & Alarming



*Alarm condition is monitored with 500 ms cycle time.

14.3 Factory Settings RadEye SPRD

Item	Factory default 425067122
Language	English
Measuring unit dose rate	Sv/h
Type of battery	Battery (Alkaline)
Mode	Count rate [cps]
Acoustic indication	Single pulse indication
Keyboard	Beep when key pressed
Display temperature	°C
Display dose	Active
Display option “upside down”	Disabled
History timer interval	120 s
Text display line 1	Line 1
Text display line 2	RadEye SPRD
Text display line 3	Line 3
Text display line 4	Line 4
Text field	This text is not shown in the LCD.
Alarm 1, Display ‘Count rate [cps]’	50
Alarm 2, Display ‘Count rate [cps]’	1000
Sigma value	6
Sigma min. Rate [cps]	30
Safety Alarm	Disabled
Alarm 1, Display ‘Dose rate’	0.50 µSv/h
Alarm 2, Display ‘Dose rate’	25.00 µSv/h
Alarm 1, Dose	10 Sv
Alarm 2, Dose	10 Sv
Alarm thresholds read only	Disabled
Alarm indicator, Sound	Enabled
Alarm indicator, LED	Enabled
Alarm indicator, Vibrator	Enabled
Alarm indicator, LCD-LED	Disabled
Alarm latching time	0s
Energy ratio	Active
Minimal rate for energy ratio [cps]	15

Sensitivity Low Energy	100%
Sensitivity Mid Energy	100%
Sensitivity High Energy	100%
Active functions	All available functions are active
Bluetooth: Power off at battery low	Enabled
Bluetooth: Blue LED on	Enabled
Bluetooth: Firewall	Enabled
Bluetooth: Secure connection	Enabled
Bluetooth PIN	1234
Bluetooth: operation mode	PC
Info Button: Dose Rate Gamma	Enabled
Info Button: Dose Gamma	Enabled
Info Button: Peak/Mean Gamma	Enabled
Info Button: Peak/Mean Neutron	Disabled
On Button: Display Neutron	Disabled
On Button: Dual Display	Disabled
On Button: Graphic Display	Enabled

15. Service contact

To request repair or calibration services, please use the online RGA (Return Goods Authorization)
process at:

http://www.thermoscientific.com/servicerepair

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